

Agriculture Policy: Vision 2020

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India has made impressive strides on the agricultural front during the last three decades. Much of the credit for this success should go to the several million small farming families that form the backbone of Indian agriculture and economy. Policy support, production strategies, public investment in infrastructure, research and extension for crop, livestock and fisheries have significantly helped to increase food production and its availability. During the last 30 years, India's foodgrain production nearly doubled from 102 million tons in the triennium ending 1973 to nearly 200 million tons (mt) in the triennium ending (TE) 1999. Virtually all of the increase in the production resulted from yield gains rather than expansion of cultivated area. Availability of foodgrains per person increased from 452 gm/capita/day to over 476 gm/capita/day, even as the country's population almost doubled, swelling from 548 million to nearly 1000 million.

Increased agricultural productivity and rapid industrial growth in the recent years have contributed to a significant reduction in poverty level, from 55 percent in 1973 to 26 percent in 1998. Despite the impressive growth and development, India is still home to the largest number of poor people of the world. With about 250 million below the poverty line, India accounts for about one-fifth of the world's poor. Child malnutrition extracts its highest toll in this country. About 25% children suffer from serious malnutrition. More than 50 percent of the pre-school children and pregnant women are anemic. The depth of hunger among the undernourished is also high.

India has high population pressure on land and other resources to meet its food and development needs. The natural resource base of land, water and bio-diversity is under severe pressure. The massive increase in population (despite the slowing down of the rate of growth) and substantial income growth, demand an extra about 2.5 mt of foodgrains annually, besides significant increases needed in the supply of livestock, fish and horticultural products. Under the assumption of 3.5% growth in per capita GDP (low income growth scenario), demand for foodgrains (including feed, seed, wastage and export) is projected in the year 2020 at the level of 256 mt comprising 112mt of rice, 82mt of wheat, 39mt of coarse grains and 22mt of pulses. The demand for sugar, fruits, vegetables, and milk is estimated to grow to a level 33mt, 77mt, 136mt and 116mt respectively. The demand for meat is projected at 9mt, fish 11 mt and eggs 77.5 billion (Table 1).

Future increases in the production of cereals and non-cereal agricultural commodities will have to be essentially achieved through increases in productivity, as the possibilities of expansion of area and livestock population are minimal. To meet the projected demand in the year 2020, country must attain a per hectare yield of 2.7 tons for rice, 3.1 tons for wheat, 2.1 tons for maize, 1.3 tons for coarse cereals, 2.4 tons for cereal, 1.3 tons for pulses, 22.3 tons for potato, 25.7 for vegetables, and 24.1 tons for fruits. The production of livestock and poultry products must be improved 61% for milk, 76% for meat, 91% for fish, and 169% for eggs by the year 2020 over the base year TE 1999. Average yields of most crops in India are still rather low.

Emerging Trends

The agriculture sector recorded satisfactory growth due to improved technology, irrigation, inputs and pricing policies. Livestock, poultry, fisheries and horticulture are surging ahead in production growth in recent years and will have greater demand in the future. Industrial and service sectors have expanded faster than agriculture sector resulting in declining share of agriculture in national accounts. Despite the structural change, agriculture still remains a key sector, providing both employment and livelihood opportunities to more than 70 percent of the country's population who live in rural areas. The contribution of small farmers to the national and household food security has been steadily increasing. The water availability for agricultural uses has reached a critical level and deserves urgent attention of all concerned.

India has high population pressure on land and other resources to meet its food and development needs. The natural resource base of land, water and bio-diversity is under severe pressure. Food demand challenges ahead are formidable considering the non-availability of favourable factors of past growth, fast declining factor productivity in major cropping systems and rapidly shrinking resource base.

Vast uncommon opportunities to harness agricultural potential still remain, which can be tapped to achieve future targets. There are serious gaps both in yield potential and technology transfer as the national average yields of most of the commodities are low, which if addressed properly could be harnessed.

Concentration was on enhanced production of a few commodities like rice and wheat, which could quickly contribute to increased total food and agricultural production. This resulted in considerable depletion of natural resources and the rainfed dry areas having maximum concentration of resource poor farmers remained ignored, aggravating problems of inequity and regional imbalances. This also led to a high concentration of malnourished people in these rainfed, low productive areas. This era also witnessed rapid loss of soil nutrients, agro-biodiversity including indigenous land races and breeds.

The agriculture policy must accelerate all-round development and economic viability of agriculture in comprehensive terms. Farmers must be provided the necessary support, encouragement and incentives. It must focus both on income and greater on-farm and off-farm job and livelihood opportunities.

Main Issues

In national priority setting, the following recurring and emerging issues for sustainable agricultural development and poverty alleviation must be considered:

- (i) Population pressure and demographic transition;
- (ii) Resource base degradation and water scarcity;
- (iii) Investment in agriculture, structural adjustment and impact on the poor;

- (iv) Globalization and implication on the poor;
- (v) Modern science and technology and support to research and technology development; and
- (vi) Rapid urbanization and urbanization of poverty, and deceleration in rural poverty reduction.

In addressing the above issues, a policy statement on agriculture must take note of the following uncommon opportunities:

- Conservation of natural resources and protection of environment.
- Vast untapped potential of our soil and water resources, and farming systems
- Technology revolution especially in the areas of molecular biology, biotechnology, space technology, ecology and management.
- Revolution in informatics and communication and the opportunity of linking farmers, extension workers and scientists with the national and international databases

Vision

The Agriculture Policy document must articulate a clear vision on following few basic parameters of the agricultural sector around which a policy framework must be developed.

- Organization of agriculture: A clear long-term vision where inter-sectoral linkages are explicit.
- Sustainability and natural resource management: Prescription must lie in the domain of political economy. Otherwise, allocating funds for watershed development, agroforestry, soil conservation, and so on will not produce desired results.
- Institutional change: Policy document must spell out new approaches and new institutions free from the shackles of bureaucratic and self-help framework.
- Investment priorities: There is a need to develop a consensus on investment themes, priorities and policies. Policy document must lend strength to the claim for greater investment in rural areas, and also re-examine its programmes in the light of complementarities.
- Incentives: Document must articulate a clear vision on the incentive framework.
- Risk management

Challenges, Policies and Strategies

Enhancing Yield of Major Commodities

Yield of major crops and livestock in the region is much lower than that in the rest of the world. Considering that the frontiers of expansion of cultivated area are almost closed in the region, the future increase in food production to meet the continuing high demand must come from increase in yield. There is a need to strengthen adaptive research and technology assessment, refinement and transfer capabilities of the country so that the existing wide technology transfer gaps are bridged. For this, an appropriate network of extension service needs to be created to stimulate and encourage both top-down and bottom-up flows of information between farmers, extension workers, and research scientists to promote the generation, adoption, and evaluation of location specific farm technologies. Ample scope exists for increasing genetic yield potential of a large number of vegetables, fruits as well as other food crops and livestock and fisheries products. Besides maintenance breeding, greater effort should be made towards developing hybrid varieties as well as varieties suitable for export purposes. Agronomic and soil researches in the region need to be intensified to address location specific problems as factor productivity growth is decelerating in major production regimes. Research on coarse grains, pulses and oilseeds must achieve a production breakthrough. Hybrid rice, single cross hybrids of maize and pigeonpea hybrids offer new opportunities. Soybean, sunflower and oil palm will help in meeting future oil demands successfully. Forest cover must be preserved to keep off climatic disturbances and to provide enough of fuel and fodder. Milk, meat and draught capacity of our animals needs to be improved quickly through better management practices.

Integrated nutrient management: Attention should be given to balanced use of nutrients. Phosphorus deficiency is now the most widespread soil fertility problem in both irrigated and unirrigated areas. Correcting the distortion in relative prices of primary fertilizers could help correct the imbalances in the use of primary plant nutrients -nitrogen, phosphorus, and potash and use of bio-fertilizers. To improve efficiency of fertilizer use, what is really needed is enhanced location-specific research on efficient fertilizer practices (such as balanced use of nutrients, correct timing and placement of fertilizers, and, wherever necessary, use of micronutrient and soil amendments), improvement in soil testing services, development of improved fertilizer supply and distribution systems, and development of physical and institutional infrastructure.

Arresting deceleration in total factor productivity: Public investment in irrigation, infrastructure development (road, electricity), research and extension and efficient use of water and plant nutrients are the dominant sources of TFP growth. The sharp deceleration in total investment and more so in public sector investment in agriculture is the main cause for the deceleration. This has resulted in the slow-down in the growth of irrigated area and a sharp deceleration in the rate of growth of fertiliser consumption. The most serious effect of deceleration in total investment has been on agricultural research and extension. This trend must be reversed as the projected increase in food and non-food production must accrue essentially through increasing yield per hectare. Recognising that there are serious yield gaps and there are

already proven paths for increasing productivity, it is very important for India to maintain a steady growth rate in total factor productivity. As the TFP increases, the cost of production decreases and the prices also decrease and stabilise. Both producer and consumer share the benefits. The fall in food prices will benefit the urban and rural poor more than the upper income groups, because the former spend a much larger proportion of their income on cereals than the latter. All the efforts need to be concentrated on accelerating growth in TFP, whilst conserving natural resources and promoting ecological integrity of agricultural system. More than half of the required growth in yield to meet the target of demand must be met from research efforts by developing location specific and low input use technologies with the emphasis on the regions where the current yields are below the required national average yield.

Literacy had a positive and significant relation with crop productivity and a strong link exists between literacy and farm modernisation. A recent study (Kumar and Mittal, 2000), has shown that literacy emerged as an important source of growth in adoption of technology, use of modern inputs like machines, fertilisers, and yield. Recognising that in the liberalised economic environment, efficiency and growth orientation will attract maximum attention. Literacy will play a far more important role in the globalised world than it did in the past. Contribution of literacy, through TFP, will be substantial on yield growth and domestic supply. As future agriculture will increasingly be science-led and will require modern economic management, high return to investment on education is expected.

The investments that are good for agricultural growth-technology and its dissemination, rural infrastructure (roads), education and irrigation - amount to a 'win-win' strategy for reducing rural poverty by also increasing the non-farm economy and raising rural wages. Creating infrastructure in less developed areas, better management of infrastructure and introduction of new technologies can further enhance resource productivity and TFP. Generation and effective assessment and diffusion of packages of appropriate technologies involving system and programme based approach, participatory mechanisms, greater congruency between productivity and sustainability through integrated pest management and integrated soil-water-irrigation-nutrient management, should be aggressively promoted to bridge the yield gaps in most field crops. Besides this, efforts must be in place to defend the gains and to make new gains particularly through the congruence of gene revolution, informatics revolution, management revolution and eco-technology.

Many observers have expressed concern that technological gains have not occurred in a number of crops, notably coarse cereals, pulses and in rainfed areas. Recent analysis on TFP growth based on cost of cultivation data does not prove this perception (Table 2). In all the 18 major crops considered in the analysis, several states have recorded positive TFP growth. This is spread over major cereals, coarse grains, pulses, oilseeds, fibres, vegetables, etc. In most cases, in the major producing states, rainfed crops also, showed productivity gains. There is thus strong evidence that technological change has generally pervaded the entire crop sector. There are, of course, crops and states where technological stagnation or decline is apparent and these are the priorities for present and future agricultural research. Farming system research to develop location specific technologies and strategy to make grey areas green by adopting three-pronged approach - watershed management, hybrid technology and small farm mechanisation will accelerate growth in TFP. It is necessary to enlarge the efforts for promoting available dry land technologies.

Promoting efficient fertiliser practices, improving soil-testing services, strengthening distribution channel of critical inputs specially quality seed and development of physical and institutional infrastructure will help resource-poor farmers.

Bridging Yield Gaps: Vast untapped potential in the yield exists for all crops in most of the states accounting for more than three-fourths of crop area. Emphasis must be given to the states in which current yield levels are below the national average yield. Bihar, Orissa, Assam, West Bengal and Uttar Pradesh are the priority states accounting for 66% of rice area which need emphasis on bridging yield gaps to attain target demand and yield growth. For wheat we must focus mainly on Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan accounting for 68% of wheat area. For coarse cereals, major emphasis must be given to Rajasthan, Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh and Uttar Pradesh. To meet the demand for pulses greater emphasis is needed in almost all the states with particular focus on Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Uttar Pradesh which have three-fourths of total pulse area. The target growth in pulse yield from these states annually must be 6 per cent; otherwise the nation will experience shortage of pulses for all times to come. The task of attaining self sufficient in pulses production looks difficult without area expansion and irrigation. In cases of oilseeds greater emphasis is needed on Andhra Pradesh, Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, West Bengal and Uttar Pradesh to increase the yield by about 4 per cent. The possibilities of developing processing industry for extracting edible oils from non-oilseeds commodities, like rice bran etc, needing to be explored. The introduction of palm cultivation for oil production may release pressure on traditional oilseeds crops to meet future edible oil demand. In case of sugarcane, research and development efforts are to be strengthened in Uttar Pradesh and Bihar to increase the yields per hectare by about 4% per annum. The demand for sugar can also be met by developing mini sugar mills so that substantial sugarcane production can be diverted from Khandasari to sugar production. This may also help release some sugarcane area to other crops. Cotton crop requires greater yield improvement emphasis on 81 per cent of the cotton area in Maharashtra, Gujarat and Andhra Pradesh.

Water for Sustainable Food Security

India will be required to produce more and more from less and less land and water resources. Alarming rates of ground water depletion and serious environmental and social problems of some of the major irrigation projects on one hand, and the multiple benefits of irrigation water in enhancing production and productivity, food security, poverty alleviation, as mentioned earlier, are well known to be further elaborated here: In India, water availability per capita was over 5000 cubic metres (m³) per annum in 1950. It now stands at around 2000 m³ and is projected to decline to 1500 m³ by 2025. Further, the quality of available water is deteriorating. Also, there are gross inequalities between basins and geographic regions.

Agriculture is the biggest user of water, accounting for about 80 percent of the water withdrawals. There are pressures for diverting water from agriculture to other sectors. A study has warned that re-allocation of water out of agriculture can have a dramatic impact on global food markets. It is projected that availability of water for agricultural use in India may be reduced by 21 percent by 2020, resulting: in drop of yields of irrigated crops, especially rice, thus price rise and withdrawal of food from poor masses. Policy reforms are needed from now to avoid the

negative developments in the years to come. These reforms may include the establishment of secure water rights to users, the decentralization and privatization of water. management functions to appropriate levels, pricing reforms, markets in tradable property rights, and the introduction of appropriate water-saving technologies.

The needs of other sectors for water cannot be ignored. Therefore it is necessary that an integrated water use policy is formulated and judiciously implemented. Several international initiatives on this aspect have been taken in recent years. India should critically examine these initiatives and develop its country-specific system for judicious and integrated use and management of water. A national institution should be established to assess the various issues, regulatory concerns, water laws and legislations, research and technology development and dissemination, social mobilization and participatory and community involvement, including gender and equity concerns and economic aspects. This institution should function in a trusteeship mode and seen as the flagship of a national system for sustainable water security.

Emphasis on Rainfed Ecosystem

Resource-poor farmers in the rainfed ecosystems practice less-intensive agriculture, and since their incomes depend on local agriculture, they benefit little from increased food production in irrigated areas. To help them, efforts must be increased to disseminate available dry land technologies and to generate new ones. It will be necessary to enlarge the efforts for promoting available dry land technologies, increasing the stock of this knowledge, and removing pro-irrigation biases in public investment and expenditure, as well as credit flows, for technology-based agricultural growth. Watershed development for raising yields of rainfed crops and widening of seed revolution to cover oilseeds, pulses, fruits and vegetables. Farming system research to develop location specific technologies must be intensified in the rainfed areas. Strategy to make grey areas green will lead to second Green Revolution, which would demand three-pronged strategy - watershed management, hybrid technology and small farm mechanisation.

Accent on Diversification of Agriculture and Value Addition

In the face of shrinking natural resources and ever increasing demand for larger food and agricultural production arising due to high population and income growths, agricultural intensification is the main course of future growth of agriculture in the region. Research for product diversification should be yet another important area. Besides developing technologies for promoting intensification, the country must give greater attention to the development of technologies that will facilitate agricultural diversification particularly towards intensive production of fruits, vegetables, flowers and other high value crops that are expected to increase income growth and generate effective demand for food. The per capita availability of arable land is quite low and declining over time. Diversification towards these high value and labour intensive commodities can provide adequate income and employment to the farmers dependent on small size of farms. Due importance should be given to quality and nutritional aspects. High attention should be given to develop post-harvest handling and agro-processing and value addition technologies not only to reduce the heavy post-harvest losses and also improve quality through proper storage, packaging, handling and transport. The role of biotechnology in post-harvest

management and value addition deserves to be enhanced.

Accent on Post-Harvest Management, Value Addition and Cost-Effectiveness

Post-harvest losses generally range from 5 to 10 percent for non-perishables and about 30 percent for perishables. This loss could be and must be minimized. Let us remember, a grain saved is a grain produced. Emphasis should therefore be placed to develop post-harvest handling, agro-processing and value-addition technologies not only to prevent the high losses, but also to improve quality through proper storage, packaging, handling and transport. With the thrust on globalization and increasing competitiveness, this approach will improve the agricultural export contribution of India, which is proportionately extremely low. Cost-effectiveness in production and post-harvest handling through the application of latest technologies will be a necessity. The agro-processing facilities should preferably be located close to the points of production in rural areas, which will greatly promote off-farm employment. Such centres of processing and value addition will encourage production by masses against mass production in factories located in urban areas. Agricultural cooperatives and Gram Panchayats must play a leading role in this effort. In doing so, the needs of small farmers should be kept in mind.

Increased Investment in Agriculture and Infrastructures

The public investment in agriculture has been declining and is one of the main reasons behind the declining productivity and low capital formation in the agriculture sector. With the burden on productivity - driven growth in the future, this worrisome trend must be reversed. Private investment in agriculture has also been slow and must be stimulated through appropriate policies. Considering that nearly 70 percent of India still lives in villages, agricultural growth will continue to be the engine of broad-based economic growth and development as well as of natural resource conservation, leave alone food security and poverty alleviation. Accelerated investment are needed to facilitate agricultural and rural development through:

- Productivity increasing varieties of crops, breeds of livestock, strains of microbes and efficient packages of technologies, particularly those for land and water management, for obviating biotic, a biotic, socio-economic and environmental constraints;
- Yield increasing and environmentally-friendly production and post-harvest and value-addition technologies;
- Reliable and timely availability of quality inputs at reasonable prices, institutional and credit supports, especially for small and resource-poor farmers, and support to land and water resources development;
- Effective and credible technology, procurement, assessment and transfer and extension system involving appropriate linkages and partnerships; again with an emphasis on reaching the small farmers;
- Improved institutional and credit support and increased rural employment opportunities, including those through creating agriculture-based rural

agro-processing and agro-industries, improved rural infrastructures, including access to information, and effective markets, farm to market roads and related infrastructure;

- Particular attention to the needs and participation of women farmers; and
- Primary education, health care, clean drinking water, safe sanitation, adequate nutrition, particularly for children (including through mid-day meal at schools) and women.

The above investments will need to be supported through appropriate policies that do not discriminate against agriculture and the rural poor. Given the increasing role of small farmers in food security and poverty alleviation, development efforts must be geared to meet the needs and potential of such farmers through their active participation in the growth process.

Government should facilitate and support community level action by private voluntary organizations, including farmers groups aimed at improving food security, reducing poverty, and assuring sustainability in the management of natural resources. In addition, governments should enhance efforts to ensure good nutrition and access to sufficient food for all through primary health care and education for all.

Modern biotechnology tools, genetic engineering, as well as conventional breeding methods are all expected to play important roles in the generation of higher yielding, pest and stress resistant varieties of rice, wheat, maize and other cereal crops. The availability of genetic innovations in developing countries will depend on continued high levels of investments in agricultural research, both at the international and the national levels. Free and unhindered access to germplasm to breeders worldwide is absolutely crucial to the rapid dissemination and adoption of improved germplasm. This free movement and the dissemination of modern biotechnology innovations to developing countries are hampered by increased patent protection and private sector investments. There is an urgent need to address this problem of free access to technology in the future.

Increased attention will also have to be given to development of sustainable systems that protect the natural resource base. Recent evidence of resource degradation and declining productivity in some intensively cropped areas is of particular concern. Also population driven intensification of agriculture without the use of external inputs, is leading to a serious problem of mining soil fertility

Sustaining global food supplies will depend on continued high levels of investments in research and technology development. It is essential that research capacity has to be increased substantially. In addition to investments in research, infrastructure investments, particularly in irrigation, transport and market infrastructure development are equally important for sustaining the productivity and profitability of food crop production.

Mobilize the best of science and development efforts (including traditional knowledge and modern scientific approach) through partnerships involving national and international research institutions, NGOs, farmers' organizations and private sector in order to tackle the present and

future problems of food security and production.

Donors and Government must urgently increase funding for agricultural research targeted at the needs of the rural and urban poor, and every effort must be made to ensure the free flow of information, technology and germplasm so that a proper sustainable agriculture can be achieved.

Fighting Poverty and Hunger

Nearly one-fourth of India's population, 251 million out of nearly one billion, is below the poverty line. One hundred seventy millions of the poor, 68 percent, are rural and the remaining 32 percent are urban (Table 4). Number at the national level in rural area has decreased after 1983; the number of poor in the cities has been increasing. This is essentially due to migration of the destitute from villages to cities. There are serious implications of this trend on feeding the cities and food security of urban people, urban poverty and environment. A question may be asked as to whether the rural settings and opportunities could be improved for securing livelihood security and consequently rationalizing the migration to the cities.

An analysis of the incidence of rural poverty and hunger by farm size revealed that more than half of the landless people are poor. Poverty got significantly reduced from 54 percent in the landless group to 38 percent in the sub-marginal group (Table 5), suggesting that even a small piece of land, less than 1/2 hectare, can greatly reduce both poverty and hunger¹. The incidence of hunger and poverty gets reduced as one is able to meet even part of his/her dietary energy requirement through growing his/her own food (Table 6). Studies show that even a small plot of one's own helps women to escape extreme poverty and deprivation. Land is the main asset for livelihood security.

Although several factors affect the extent and depth of poverty and hunger, some of them have overwhelming impacts under the Indian setting. These include, irrigation, farming system and literacy. Generally, there is higher concentration of poor, and hungry people in rainfed areas as compared with those in irrigated zones. Even with 20 percent of the irrigation intensity, there is a sharp fall in the proportion of hunger and poverty and it remains there irrespective of further intensification of irrigation (Table 7). Evidences suggest that extensive irrigation will prove much more effective than to adding more and more water, and often wasting it along with the associated degradation of the natural resources. Such a policy will not only reduce poverty and hunger, but will also promote equity and environmental protection and natural resource conservation. An effective water policy and institutional support is needed to ensure judicious and equitable allocation, distribution and exploitation of water and water resources.

Livestock has the highest effect on reducing poverty and hunger. In rural India, 43 percent of the people who do not own even a single livestock are malnourished. Addition of one

¹ Energy intake below minimum energy requirement (kcal/person/day). Three-fourth of recommended calories (2400/person/day) for rural India that is 1800 kcal/person/day is used the threshold level. An average individual has an intake below this level (the threshold) is undernourished because they do not eat enough to maintain health, body weight and to undertake light activity.

cattle or one buffalo to their assets reduces the hunger prevalence by 16 and 25 percentage points, respectively (Table 8). Only 14 percent of the people who owned one cattle and one buffalo were malnourished. In urban areas also, the addition of one cattle or one buffalo had significant impact on reduction of proportion of malnourished people. Livestock sector should also receive high priority with multiple objectives of diversifying agriculture, raising income and meeting the nutritional security of the poor farm households.

Literacy has a very high impact on poverty alleviation as well as on hunger reduction (Table 9). The illiterate people, whether urban or rural, are the most poor and malnourished. In urban areas the impact of literacy on poverty is the highest. Education, even above primary level, is extremely effective in reducing both poverty and hunger. Graduate and technical education is, of course, the most important instrument for reducing both poverty and hunger. But its impact is most visible on poverty reduction. Therefore, the education policy of the country must be geared to remove illiteracy as soon as possible, as 50 percent of our people are still illiterate. Free education up to 8th standard coupled with mid-day meal in the schools will go a long way in reducing both poverty and hunger and will thus help build a strong India. Further, this move will greatly reduce the violation of child labour laws and will offset some of the non-tariff restrictions imposed by developed countries on exports from developing countries on the grounds of use of child labour.

Accent on Empowering the Small Farmers

Contributions of small holders in securing food for growing population have increased considerably even though they are most insecure and vulnerable group in the society. The off-farm and non-farm employment opportunities can play an important role. Against expectation under the liberalized scenario, the non-agricultural employment in rural areas has not improved. Greater emphasis needs to be placed on non-farm employment and appropriate budgetary allocations and rural credit through banking systems should be in place to promote appropriate rural enterprises. Specific human resource and skill development programmes to train them will make them better decision-makers and highly productive. Human resource development for increasing productivity of these small holders should get high priority. Thus, knowledge and skill development of rural people both in agriculture and non-agriculture sectors is essential for achieving economic and social goals. A careful balance will therefore need to be maintained between the agricultural and non-agricultural employment and farm and non-farm economy, as the two sectors are closely inter-connected.

Raising agricultural productivity requires continuing investments in human resource development, agricultural research and development, improved information and extension, market, roads and related infrastructure development and efficient small-scale, farmer-controlled irrigation technologies, and custom hiring services. Such investments would give small farmers the options and flexibility to adjust and respond to market conditions.

For poor farm-households whose major endowment is its labour force, economic growth with equity will give increased entitlement by offering favourable markets for its products and more employment opportunities. Economic growth if not managed suitably, can lead to growing inequalities. Agrarian reforms to alleviate unequal access to land, compounded by unequal access

to water, credit, knowledge and markets, have not only rectified income distribution but also resulted in sharp increases in productivity and hence need to be adopted widely. Further, targeted measures that not only address the immediate food and health care requirements of disadvantaged groups, but also provide them with developmental means, like access to inputs, infrastructure, services and most important, education should be taken.

Identification of need-based productive programs is very critical, which can be explored through characterisation of production environment. We have to develop demand-driven and location-specific programs to meet the requirements of different regions to meet the nutritional security of most vulnerable population in the rural areas. Improved agricultural technology, irrigation, livestock sector and literacy will be most important instruments for improving the nutritional security of the farm-households. Watershed development and water saving techniques will have far reaching implications in increasing agricultural production and raising calorie intake in the rainfed areas. Livestock sector should receive high priority with multiple objectives of diversifying agriculture, raising income and meeting the nutritional security of the poor farm households. Need based and location-specific community programs, which promise to raise nutritional security, should be identified and effectively implemented. Expansion of micro credit programmes for income-generation activities, innovative approaches to promote family planning and providing primary health services to people and livestock and education should enhance labour productivity and adoption of new technologies. Development of the post-harvest sector, co-operatives, roads, education, and research and development should be an investment priority. A congenial policy environment is needed to enable smaller holders to take the advantage of available techniques of production, which can generate more incomes and employment in villages. For this poor farmer needs the support of necessary services in the form of backward and forward linkages. Small-mechanised tools, which minimise drudgery and do not reduce employment, but only add value to the working hours are needed to enhance labour productivity. Special safety nets should be designed and implemented for them. Can agricultural co-operatives internalise and galvanize these marginal and excluded people? Off-farm employment provided through co-operatives will go a long way in pulling them out of the state where poverty breeds poverty. Therefore, investment in the empowerment of the small landholders will pay off handsomely. Let us create rural centres of production and processing by masses through co-operatives or empowerment of Gram Panchayats to promote co-operatives. This will improve efficiency of input and output marketing and give higher income. There is need to disseminate widely post-harvest handling and agro-processing and value addition technologies not only to reduce the heavy post-harvest losses but also improve quality through proper storage, packaging, handling and transport. Panchayati Raj institutions and co-operatives can play significant role in all these directions. Giving them power over the administration, as contemplated under the 73rd and 74th Amendment of the Constitution has not been implemented seriously so far in any of the states.

Disaster Management

The frequency and intensity of disasters such as floods, droughts, cyclones and earthquakes have increased in the recent years. The devastating earthquake in Gujarat has brought untold miseries to the whole state and caused a national disaster. Special effort should be made to develop appropriate technologies for increasing preparedness to predict and to manage the disasters. Effective and reliable information and communication systems, contingency planning and national and international mobilization of technologies and resources are a must. Experiences

of other countries in prevention and management of the disasters should be shared.

Keeping Pace with Globalisation

The globalization of agricultural trade will bring to the fore access to markets; new opportunities for employment and income generation; productivity gains and increased flow of investments into sustainable agriculture and rural development. I believe that if managed well, the liberalization of agricultural markets will be beneficial to developing countries in the long run, It will force the adoption of new technologies, shift production functions upwards and attract new capital into the deprived sector. However, this will only come to pass if we are mindful of the interests of billions of small and subsistence oriented farmers, fisher-folk and forest dwellers in the short and medium term. So far the magic of globalization has not been felt in India. During the past one-decade of liberalization certain trends such as deceleration of the growth rate of agricultural GDP, decline in yield growth rates, and low non-agricultural employment have emerged against expectations. As we globalize, however, it is imperative that we do not forget social aspirations for a more just, equitable and sustainable way of life. Trade agreements must be accompanied by operationally effective measures to ease the adjustment process for a small farmer in developing countries.

Exploiting Cyberspace

Information is power and will underpin future progress and prosperity. Efforts must be made to strengthen the informatics in agriculture by developing new databases, linking databases with international databases and adding value to information to facilitate decision making at various levels. Development of production models for various agro-ecological regimes to forecast the, production potential should assume greater importance. Using the remote sensing and GIS technologies, natural and other agricultural resource should be mapped at micro and macro levels and effectively used for land and water use planning as well as agricultural forecasting, market intelligence and e-business, contingency planning and prediction of disease and pest incidences.

Table 1: Demand for Agricultural Commodities

Item	Achieved TE 1997-99			Demand in 2020 (million tons)		Yield target in 2020	
	Area (Million ha)	Production (Million tons)	Yield (Kg/ha)	LIG	HIG	LIG	HIG
Rice	42.2	85.7	1903	112.4	111.9	2664	2652
Wheat	26.2	69.1	2582	82.3	79.9	3137	3045
Coarse cereal	30.7	30.4	1041	38.9	37.3	1268	1214
Cereal	99.1	185.2	1814	233.6	229.0	2357	2311
Pulses	21.7	13.8	608	22.3	23.8	1029	1095
Foodgrains	120.8	199.0	1595	255.9	252.8	2119	2092
Edible oil	28.6	6.4	269	10.8	11.4	379.7	399
Potato	1.2	21.6	17188	27.8	30.6	22279	24566
Vegetables	5.3	74.5	14204	135.6	168.0	25673	31812
Fruits	3.2	43.0	13437	77.0	93.6	24064	29259
Sugarcane Gur	3.7	26.9	7006	32.6	33.7	8788	9088
Milk	-	71.2	-	115.8	137.3	-	-
Meat	-	5.0	-	8.8	11.4	-	-
Eggs number	-	2873	-	7750	10000	-	-
Fish	-	5.3	-	10.1	12.8	-	-

Source: R.S.Paroda and Praduman Kumar (2000). Food Production and Demand in South Asia. Agril. Econ. Res. Rev. 13(1):1-24.

LIG: Low income growth 3.5% per capita GDP growth

HIG: High income growth 5.5% per capita GDP growth

Demand includes export 4.7mt rice, 3.6 mt wheat, and vegetables 2.2 mt fruits 1.4mt
And fish 0.49 mt.

Table 2: Total Factor Productivity trends for crops in selected states

Crop	TFP trend		
	Increasing	No change	Declining
Paddy	Andhra Pradesh, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal	Assam, Haryana	Bihar, Karnataka, Madhya Pradesh
Wheat	Haryana, Punjab, Rajasthan, Uttar Pradesh	Madhya Pradesh	
Sorghum	Andhra Pradesh, Maharashtra, Karnataka	Madhya Pradesh, Rajasthan	
Pear millets	Gujarat, Haryana, Rajasthan		
Maize	Madhya Pradesh	Rajasthan, Uttar Pradesh	
Barley	Uttar Pradesh	Rajasthan	
Chickpea	Haryana	Rajasthan, Uttar Pradesh	Madhya Pradesh
Black gram	Maharashtra	Andhra Pradesh, Madhya Pradesh, Uttar Pradesh	Orissa
Moong	Madhya Pradesh	Andhra Pradesh, Rajasthan	Orissa
Pigeon pea	Madhya Pradesh	Gujarat, Uttar Pradesh	
Groundnut	Andhra Pradesh, Karnataka, Maharashtra, Orissa	Gujarat, Tamil Nadu	
Rapeseed & Mustard	Rajasthan, Uttar Pradesh	Assam, Haryana	Punjab
Soyabean		Madhya Pradesh	
Sugarcane	Bihar	Andhra Pradesh, Haryana, Karnataka, Maharashtra, Uttar Pradesh	
Cotton	Gujarat, Haryana, Tamil Nadu	Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab	
Jute	Assam, Bihar, West Bengal		Bihar
Onion	Maharashtra	Himachal Pradesh	
Potato	Uttar Pradesh	Himachal Pradesh	

Source: IARI-FAO/RAP study (2001) based on cost of cultivation data, DES, GOI.

Table 3: Priority states for increasing national average yield of crops, India

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Crops	Target growth Per cent	Priority states	Percent share of priority states in total crop area
Rice	2.35	BH, OR, AS, WB, UP	66
Wheat	2.22	UP, MP, BH, RJ	68
Sorghum	1.36	MH, KN, MP, AP	82
Pear-millet	0.43	RJ	47
Maize	2.00	BH, UP, MP, RJ	60
Chickpea	4.34	MP, RJ, UP, MH	83
Pigeon pea	4.28	MH, GJ, KN, AP, MP	72
Groundnut	2.51	AP, GJ, KN, MH	76
Rapeseed & Mustard	2.11	RJ, UP, MP, WB	74
Soyabean	1.11	MP, RJ	83
Cotton	3.78	MH, GJ, KN, RJ, AP	74
Sugarcane	3.07	UP	51

Note: AP: Andhra Pradesh. AS: Assam. BH: Bihar. GJ: Gujarat. KN: Karnataka. MP: Madhya Pradesh. MH: Maharashtra. OR: Orissa RJ: Rajasthan. UP: Uttar Pradesh. WB: West Bengal.

Table 4. Number and percentage of population below poverty line in India

Year	Rural		Urban		All India	
	No. of persons (million)	% of person	No. of persons (million)	% of person	No. of persons (million)	% of person
1973	261	56	60	49	321	55
1983	254	46	74	41	328	45
1993	213	33	75	32	288	32
1998	170	24	81	30	251	26

Source: IARI-FAO/RAP study (2001) based on 50th NSS round (1993-94)

Table 5. Incidence of hunger and poverty by farm size in rural India

Land class	Percent of population	
	Hungry	Poor
Land less	49	54
<0.5 ha	32	38
0.5-1ha	24	27
1.0-2ha	17	19
2.0-4ha	12	14
>4ha	12	13

Source: IARI-FAO/RAP study (2001) based on 50th NSS Round(1993-94)

Table 6 Relationship between home produced calories and hunger and poverty in rural India

Degree of home produced calories	Percent of population	
	Hungry	Poor
0	49	41
< 25 percent	36	34
25-50 percent	26	25
50-75 percent	23	20
>75 percent	17	29

Source: IARI-FAO/RAP study (2001) based on 50th NSS Round (1993-94)

Table 7. Impact of irrigation on alleviation of hunger and poverty in India

Irrigated area (%)	Percent of population	
	Hungry	Poor
Rainfed	33	35
<20	20	22
20-50	22	23
50-80	18	24
>80	19	26

Source: IARI-FAO/RAP study (2001) based on 50th NSS Round (1993-94)

Table 8. Impact of livestock on alleviation of hunger and poverty in India

Livestock	Percent of population			
	Rural		Urban	
	Hunger	Poor	Hunger	Poor
None	36	28	43	55
Cow	31	25	29	42
Buffalo	26	18	20	33
Cow & buffalo	14	8	7	4

Source: IARI-FAO/RAP study (2001) based on 50th NSS Round (1993-94)

Table 9. Impact of literacy on alleviation of hunger and poverty in India

Literacy level	Percent of population			
	Malnourished		Below poverty level	
	Rural	Urban	Rural	Urban
Zero	36	28	43	55
Below Primary Level	31	25	29	42
Above Primary Level	26	18	20	33
Graduate and Technical	14	8	7	4

Source: IARI-FAO/RAP study (2001) based on 50th NSS Round (1993-94)